IN THE DRAWINGS

Please replace the drawings as originally filed with the attached replacement pages (11 replacement pages).

REMARKS

In the Office Action, claims 1-6, 10, 12, 14-23, 27, 29 and 31-39 were rejected. Claims 7-9, 11, 13, 24-26, 28 and 30 were objected to. Reconsideration and allowance of all pending claims are requested.

Objections to Specification and Drawings

The Examiner objected to paragraph 0043 on page 12 of the specification because the equation was not clear. Accordingly, Applicants submit that paragraph 0043 has been amended to correct the informalities. Applicants are unclear as to the manner of showing the correction, but kindly request that the Examiner accept the clean version submitted herewith.

The Examiner also objected to paragraph 0074 because the rectangle 34 is not shown in FIG. 5. Accordingly, Applicants submit that FIG. 5 has been amended to correct the informality and replacement drawings are attached with the present response.

The Examiner objected to line 3 in paragraph 0080 on page 26 of the specification. Accordingly, Applicants submit that paragraph 0080 has been amended to correct the informalities.

Rejections Under 35 U.S.C. §103

Claims 1-3, 5, 6, 14, 19, 20, 22, 23, and 31 stand rejected under 35 U.S.C. §103(a) as being unpatentable over "Optimization of broadband transducer designs by use of statistical design of experiments", IEEE 1995 (hereinafter "McKeighen") in view of U.S. Patent Application No. 2001/0056236 (hereinafter "Angelsen"), and further in view of U.S. Patent No. 6,692,439 (hereinafter "Walker") and U.S. Patent Application No. 2001/0056256 (hereinafter "Hughes").

Claims 32-35 stand rejected under 35 U.S.C. §103(a) as being unpatentable over McKeighen in view of U.S. Patent No. 6,741,265 (hereinafter "Ghosh"), and further in view of U.S. Patent No. 6,674,879 (hereinafter "Weisman").

Claims 38 and 39 stand rejected under 35 U.S.C. §103(a) as being unpatentable over McKeighen in view of Angelsen, Walker, and Weisman, and further in view of U.S. Patent No. 6,621,917 (hereinafter "Vilser").

Claims 1, 14, 31, 32, 38 and 39 are independent. All of the recited claims are believed to be patentable as cited below.

Even in combination, McKeighen, Angelsen, Walker and Hughes fail to disclose jointly optimizing the performance of a probe and imager combination.

Claim 1 and the Claims Depending Therefrom.

Claim 1 recites, *inter alia*, a method for jointly optimizing the performance of a probe and imager combination. The method includes simulating images of a phantom which would be produced by said probe and imager combination in accordance with a statistical design of experiment, a probe geometry specification, and a set of imager parameters. The said statistical design of experiment allows a subset of said imager parameters to vary. Further, the method includes quantifying the diagnostic value of each image simulated based at least in part on an image quality specification to produce simulation-based image quality data.

The Examiner argued that McKeighen is believed to teach a method of jointly optimizing the performance of a probe and imager combination. In particular, the Examiner argues that McKeighen teaches simulating images of a phantom which would be produced by the probe and imager combination in accordance with a statistical design of experiment. The Examiner cited the Abstract in support of the rejection, for example.

The cited passage reads:

> Optimizing designs that involve several parameters is a multidimensional problem, and the optimum setting of one parameter may depend on the exact setting of other parameters. Statistical design of experiments is a powerful methodology to efficiently find the optimum operating points, especially when interactions between terms is important. Here, the methodology will be described and applied to a *transducer design problem* to *optimize bandwidth and impulse response*. The design problem involves four interactive factors, the acoustic impedance of the first and second matching layer, and the appropriate thicknesses of the first and second matching layer. [Emphasis added]

The cited passage from McKeighen does not support the Examiner's position, however. Applicants respectfully submit that McKeighen teaches a method for optimizing the designs of *broadband transducers* by use of statistical design of experiments. In particular, the method recited in McKeighen teaches optimizing *bandwidth* and *impulse response* of the broadband transducers by use of statistical design of experiments. Further, the method recited in McKeighen teaches optimizing the transducer design via optimizing four interactive factors, the acoustic impedance of the first and second matching layer, and the appropriate thicknesses of the first and second matching layer.

Applicants respectfully reiterate that McKeighen fails to consider the increasingly significant coupling between the imager parameters and the probe design. Particularly, when the aperture is divided into several rows in the slice thickness dimension, such as in active matrix arrays, the image quality consequences of such coupling becomes acute. Further, the matching of a new prototype probe to a given ultrasound imager is highly resource-intensive. Parameters such as the F-numbers for each focal zone and receive depth may be varied to improve image quality parameters such as image uniformity, detail and contrast resolution.

Hence, Applicants respectfully submit that McKeighen does not teach a method of *jointly* optimizing the performance of a probe and imager combination as presented in the current application.

In addition, the Examiner acknowledged that McKeighen does not explicitly teach simulating images of a phantom which would be produced by the probe and imager combination in accordance with a probe geometry specification. Furthermore, the Examiner relied upon Angelsen to teach simulation of images of a phantom which would be produced by the probe and imager combination in accordance with a probe geometry specification. The Examiner cited the paragraphs 0030 through 0032 on page 3, in support of the rejection, for example.

The cited passage at paragraph 0030 reads:

> The ultrasound transducer array comprises an electro-acoustic active layer divided into several transducer elements with a front face and a back face, a 1st thin electrode layer covering the front face, and a 2nd thin electrode layer covering the back face. The electrodes are electrically connected to electrical terminals for coupling of energy between the electric terminals and acoustic vibrations in the transducer elements.

The cited passage from Angelsen does not support the Examiner's position, however. Applicants respectfully submit that Angelsen teaches a method for detection of ultrasound contrast agent in soft tissue utilizing an ultrasound transmit beam former and transducer array assembly that transmits directive, focused ultrasound pressure pulses towards the region of soft tissue that contains ultrasound contrast agent.

As can be seen from the cited passage and as summarized hereinabove, Angelsen teaches a method for detection of ultrasound contrast agent in soft tissue utilizing an ultrasound transmit beam former and transducer array assembly. After careful review, Applicants reiterate that Angelsen does not teach simulating images of a phantom which

would be produced by the probe and imager combination in accordance with a probe geometry specification.

Further, the Examiner acknowledged that McKeighen does not explicitly teach simulating images of a phantom which would be produced by the probe and imager combination in accordance with a set of imager parameters. Furthermore, the Examiner relied upon Walker to teach simulation of images of a phantom which would be produced by the probe and imager combination in accordance with a set of imager parameters. The Examiner cited the FIGs. 3A, 3B and 8A, and passages at col. 1, lines 39-41, in support of the rejection.

The cited passage at col. 1 reads:

> The brightness of these images is a function of many factors including transmit and receive transducer geometry, attenuation and phase aberration in the propagation path, and most importantly, the acoustic scattering of the tissue itself.

The cited passage from Walker does not support the Examiner's position, however. Applicants respectfully submit that Walker teaches a method for imaging a target that utilizes translating apertures to acquire data at a number of angles of interrogation.

As can be seen from the cited passage and as summarized hereinabove, Walker teaches a method for imaging a target. After careful review, Applicants reiterate that Walker does not teach simulating images of a phantom which would be produced by the probe and imager combination in accordance with a set of imager parameters.

In addition, the Examiner acknowledged that McKeighen does not explicitly teach quantifying the diagnostic value of each image simulated based at least in part on an image quality specification. Furthermore, the Examiner relied upon Hughes to teach

quantifying the diagnostic value of each image simulated based at least in part on an image quality specification. The Examiner cited lines 29-33 of paragraph [0078] on page 8, in support of the rejection.

The cited passage reads:

> As the image is being displayed and evaluated, alteration of the image quality by alteration of the delivery rate will result in images of higher diagnostic significance, and hence the imaging procedure will be of a higher diagnostic value and be more cost- and time-efficient.

As before, however, the cited passage from Hughes does not support the Examiner's position. Applicants respectfully submit that Hughes teaches a method for providing a volume of a suspended agent using a propellant fluid.

As can be seen from the cited passage and as summarized hereinabove, Hughes teaches a method for providing a suspended agent such as a contrast agent without mechanical resuspension. After careful review, Applicants reiterate that Hughes does not teach quantifying the diagnostic value of each image simulated based at least in part on an image quality specification.

For the reasons summarized hereinabove, Applicants respectfully submit that there is no motivation to combine McKeighen, Angelsen, Walker and Hughes. And even if the references were to be combined, the combination fails to teach the above-mentioned recitations of independent claim 1. In particular, Applicants respectfully submit that the Examiner has failed to provide a basis in the art for combining the applied references that would support a *prima facie* case of obviousness for independent claim 1.

Hence, Applicants respectfully submit that a *prima facie* case of obviousness has not been established. Accordingly, Applicants respectfully submit that independent claim 1 and claims depending therefrom are allowable and respectfully request the Examiner to reconsider rejection of the claims.

Claim 14 and the Claims Depending Therefrom.

Claim 14 recites, *inter alia*, a computer system comprising a display monitor, an operator interface. The computer system includes programming for simulating images of a phantom which would be produced by a probe and imager combination in accordance with a statistical design of experiment selected via the operator interface. The probe geometry specification comprises at least a portion specified via the operator interface. The set of imager parameters comprises at least one imager parameter set via the operator interface. The statistical design of experiment allows a subset of the imager parameters to vary. The computer system also includes programming for controlling the display monitor to display the simulated image. In addition, the computer system includes programming for quantifying the diagnostic value of each image simulated based at least in part on an image quality specification to produce simulation-based image quality data.

As discussed above for claim 1, the Examiner relied upon a combination of McKeighen, Angelsen, Walker and Hughes for teaching all of the claimed recitations. In view of the above arguments and for the same reasons, Applicants submit that claim 14 is clearly patentable over the cited references.

Hence, Applicants respectfully submit that even in combination, the references cited fail to teach the recitations of independent claim 14. Accordingly, Applicants respectfully submit that a *prima facie* case of obviousness has not been established for independent claim 14 or the claims depending therefrom and respectfully request the Examiner to reconsider rejection of the claims.

Claim 31 and the Claims Depending Therefrom.

Claim 31 recites, *inter alia*, a computer system comprising a display monitor, an operator interface. The computer system includes means for simulating images of a phantom which would be produced by a probe and imager combination in accordance with a statistical design of experiment selected via the operator interface. As before, the probe geometry specification comprises at least a portion specified via the operator interface, and the set of imager parameters comprising at least one imager parameter set via the operator interface. The statistical design of experiment allows a subset of the imager parameters to vary. Further, the computer system includes means for controlling the display monitor to display the simulated images. Additionally, the computer system includes means for quantifying the diagnostic value of each image simulated based at least in part on an image quality specification to produce simulation-based image quality data.

As discussed above for claim 1, the Examiner relied upon a combination of McKeighen, Angelsen, Walker and Hughes for teaching all of the claimed recitations.

Hence, Applicants respectfully submit that, even in combination, the references cited do not teach the recitations of independent claim 31. Accordingly, Applicant respectfully submits that a *prima facie* case of obviousness has not been established for independent claim 31 or the claims depending therefrom and respectfully request the Examiner to reconsider rejection of the claims.

Claim 32 and the Claims Depending Therefrom.

Claim 32 recites, *inter alia*, a computer system comprising first and second computers connected via a network, wherein the first computer is programmed with transducer design advisor software for generating a series of graphical user interface windows. Files are created which define a design of experiment analysis based at least in part on inputs to the windows. The files are uploaded to the second computer, and the

second computer is programmed with simulation software for simulating images of a phantom in accordance with a design of experiment defined by the uploaded files.

The Examiner rejected independent claim 32 under 35 U.S.C. §103(a) as being unpatentable over McKeighen in view of Ghosh, and further in view of Weisman. Applicants respectfully wish to bring to the attention of the Examiner that Ghosh and the present invention were commonly assigned or under an obligation of assignment to General Electric Company at the time the present invention was made. Thus, because Ghosh only qualifies as prior art under 35 U.S.C. §102(e), it may not be used as a reference against the current application under 35 U.S.C. §103(a) in view of the provisions of 35 U.S.C. §103(c). Therefore, Applicants respectfully submit that a *prima facie* case of obviousness of claim 32 cannot have been maintained as Ghosh is not available under 35 U.S.C. §103(a).

Accordingly, Applicants respectfully submit that a *prima facie* case of obviousness has not been established for independent claim 32 or the claims depending therefrom and respectfully request the Examiner to reconsider rejection of the claims.

Even in combination, McKeighen, Angelsen, Walker, Weisman and Vilser fail to disclose recitations of claims 38 and 39.

Claim 38.

Claim 38 recites, *inter alia*, a method of setting up a simulation in a design of experiment mode. The method includes specifying a probe geometry characteristic by interacting with a first graphical user interface window, and specifying an imager parameter by interacting with a second graphical user interface window. A weighting coefficient is then specified for an image quality parameter by interacting with a third user interface window. Computer files are created comprising specifications specified during the specifying steps in response to an input to a fourth user interface window.

The Examiner argued that McKeighen is believed to teach a method of setting up a simulation in a design of experiment mode. The Examiner cited lines 4-6 of the Abstract in support of the rejection, for example.

The cited passage reads:

> Statistical design of experiments is a powerful methodology to efficiently find the optimum operating points, especially when interactions between terms is important.

Further, the Examiner argued that McKeighen is believed to teach creating computer files comprising specifications specified during the specifying steps in response to an input. The Examiner cited lines 4-8 of paragraph 2 in col. 2 on page 69 in support of the rejection.

The cited passage reads:

> By optimizing the electrical impedance matching as well as the acoustic stack (ceramic, matching layers, lens, and backing) via SDOE, relative frequency bandwidths of 100%, with high sensitivity and good pulse integrity can be achieved.

As discussed above for claim 1, the cited passage from McKeighen does not support the Examiner's position. Applicants respectfully submit that McKeighen teaches a method for optimizing the designs of *broadband transducers* by use of statistical design of experiments. In particular, the method recited in McKeighen teaches optimizing *bandwidth* and *impulse response* of the broadband transducers by use of statistical design of experiments. Further, the method recited in McKeighen teaches optimizing the transducer design via optimizing four interactive factors, the acoustic impedance of the first and second matching layer, and the appropriate thicknesses of the first and second matching layer.

Hence, Applicants respectfully submit that McKeighen does not teach creating computer files comprising specifications specified during the specifying steps in response to an input.

In addition, the Examiner acknowledged that McKeighen does not explicitly teach simulating images of a probe geometry specification. Furthermore, the Examiner relied upon Angelsen to teach specifying a probe geometry characteristic. The Examiner cited the paragraphs 0030 through 0032 on page 3, in support of the rejection, for example.

The cited passage at paragraph 0030 reads:

> The ultrasound transducer array comprises an electro-acoustic active layer divided into several transducer elements with a front face and a back face, a 1st thin electrode layer covering the front face, and a 2nd thin electrode layer covering the back face. The electrodes are electrically connected to electrical terminals for coupling of energy between the electric terminals and acoustic vibrations in the transducer elements.

The cited passage from Angelsen also does not support the Examiner's position. Applicants respectfully submit that Angelsen teaches a method for detection of ultrasound contrast agent in soft tissue utilizing an ultrasound transmit beam former and transducer array assembly that transmits directive, focused ultrasound pressure pulses towards the region of soft tissue that contains ultrasound contrast agent.

As can be seen from the cited passage and as summarized hereinabove, Angelsen teaches a method for detection of ultrasound contrast agent in soft tissue utilizing an ultrasound transmit beam former and transducer array assembly. After careful review, Applicants reiterate that Angelsen does not teach specifying a probe geometry specification.

Further, the Examiner acknowledged that McKeighen does not explicitly teach specifying an imager parameter. Furthermore, the Examiner relied upon Walker to teach specifying an imager parameter. The Examiner cited the FIGs. 3A, 3B and 8A, and passages at col. 1, lines 39-41, in support of the rejection.

The cited passage at col. 1 reads:

> The brightness of these images is a function of many factors including transmit and receive transducer geometry, attenuation and phase aberration in the propagation path, and most importantly, the acoustic scattering of the tissue itself.

The cited passage from Walker does not support the Examiner's position. Applicants respectfully submit that Walker teaches a method for imaging a target that utilizes translating apertures to acquire data at a number of angles of interrogation.

As can be seen from the cited passage and as summarized hereinabove, Walker teaches a method for imaging a target. After careful review, Applicants reiterate that Walker does not teach specifying an imager parameter.

In addition, the Examiner acknowledged that McKeighen does not explicitly teach specifying a weighting coefficient for an image quality parameter. Furthermore, the Examiner relied upon Vilser to teach specifying a weighting coefficient for an image quality parameter. The Examiner cited lines 33-36 of col. 37, in support of the rejection.

The cited passage reads:

> [T]hese weighting factors are used in the determination of average values for greater weighting of more dependable measured values and for attenuating or elimination of more uncertain measured values.

The cited passage from Vilser does not support the Examiner's position. Applicants respectfully submit that Vilser teaches a method for examination of biologic vessels.

As can be seen from the cited passage and as summarized hereinabove, Vilser teaches a method for examining biologic vessels. However, in the current application, the weighting coefficients are employed to normalize y_i. In other words, the weighting coefficients may be employed to represent percentage improvement or degradation of a certain DOE parameter. After careful review, Applicants reiterate that Vilser does not teach specifying a weighting coefficient for an image quality parameter.

Furthermore, the Examiner acknowledged that McKeighen does not explicitly teach specifying a probe geometry characteristic by interacting with a first graphical user interface window, specifying an imager parameter by interacting with a second graphical user interface window, specifying a weighting coefficient for an image quality parameter by interacting with a third user interface window, and creating computer files comprising specifications specified during the specifying steps in response to an input to a fourth user interface window. The Examiner relied upon Weisman to teach all of these recitations. The Examiner cited FIGs. 5-10 and lines 19-27 in col. 1 and lines 54-59 in col. 4, in support of the rejection.

The cited passage at col. 4 reads:

> The physician interacts with the echocardiography workstation though a graphical user interface or by voice commands to view images, to select alternative processing options, to consult reference sources, to generate reports from pull-down menus, and to store, to retrieve and transmit digitized images and reports.

Here again, the cited passage from Weisman does not support the Examiner's position. Applicants respectfully submit that Weisman teaches a method for imaging internal anatomy of a patient. In particular, Weisman teaches a method that facilitates an user to generate reports, and to store, to retrieve and transmit digitized images and reports.

As can be seen from the cited passage and as summarized hereinabove, Weisman teaches a method for enhancing the image quality and diagnostic capabilities of conventional medical diagnostic ultrasound imaging systems. After careful review, Applicants reiterate that Weisman does not teach specifying a probe geometry characteristic by interacting with a first graphical user interface window, specifying an imager parameter by interacting with a second graphical user interface window, specifying a weighting coefficient for an image quality parameter by interacting with a third user interface window, and creating computer files comprising specifications specified during the specifying steps in response to an input to a fourth user interface window.

For the reasons summarized hereinabove, Applicants respectfully submit that there is no motivation to combine McKeighen, Angelsen, Walker, Weisman and Vilser. Moreover, even if the references were to be combined, the combination fails to teach the above-mentioned recitations of independent claim 38. In particular, Applicants respectfully submit that the Examiner has failed to provide a basis in the art for combining the applied references that would support a *prima facie* case of obviousness for the independent claim 38 and respectfully request the Examiner to reconsider rejection of the claim.

Claim 39.

Claim 39 recites, *inter alia*, a graphical user interface comprising a sequence of windows which allow a user to set up a simulation in a design of experiment mode. The

sequence of windows includes a first window for enabling a user to specify a probe geometry characteristic, a second window for enabling a user to specify an imager parameter, a third window for enabling the user to specify a weighting coefficient corresponding to an image quality parameter, and a fourth window for activating creation of computer files comprising specifications specified using the first through third windows.

The Examiner argued that McKeighen is believed to teach creating computer files comprising specifications specified during the specifying steps in response to an input. The Examiner cited lines 4-8 of paragraph 2 in col. 2 on page 69 in support of the rejection.

In addition, the Examiner acknowledged that McKeighen does not explicitly teach specifying a probe geometry characteristic. Furthermore, the Examiner relied upon Angelsen to teach specifying a probe geometry characteristic. The Examiner cited the paragraphs 0030 through 0032 on page 3, in support of the rejection, for example.

As discussed with respect to claim 1, the cited passage from Angelsen does not support the Examiner's position. Applicants respectfully submit that Angelsen teaches a method for detection of ultrasound contrast agent in soft tissue utilizing an ultrasound transmit beam former and transducer array assembly. After careful review, Applicants reiterate that Angelsen does not teach specifying a probe geometry specification.

Further, the Examiner also acknowledged that McKeighen does not explicitly teach specifying an imager parameter. Furthermore, the Examiner relied upon Walker to teach specifying an imager parameter. The Examiner cited the FIGs. 3A, 3B and 8A, and passages at col. 1, lines 39-41, in support of the rejection.

As discussed with respect to claim 1, the cited passage from Walker does not support the Examiner's position, however. Applicants respectfully submit that Walker teaches a method for imaging a target that utilizes translating apertures to acquire data at a number of angles of interrogation. After careful review, Applicants reiterate that Walker does not teach specifying an imager parameter.

In addition, the Examiner further acknowledged that McKeighen does not explicitly teach specifying a weighting coefficient for an image quality parameter. Furthermore, the Examiner relied upon Vilser to teach specifying a weighting coefficient for an image quality parameter. The Examiner cited lines 33-36 of col. 37, in support of the rejection.

As discussed with respect to claim 38, the cited passage from Vilser does not support the Examiner's position. Applicants respectfully submit that Vilser teaches a method for examination of biologic vessels. After careful review, Applicants reiterate that Vilser does not teach specifying a weighting coefficient for an image quality parameter.

Furthermore, the Examiner acknowledged that McKeighen does not explicitly teach specifying a probe geometry characteristic by interacting with a first graphical user interface window, specifying an imager parameter by interacting with a second graphical user interface window, specifying a weighting coefficient for an image quality parameter by interacting with a third user interface window, and creating computer files comprising specifications specified during the specifying steps in response to an input to a fourth user interface window. Furthermore, the Examiner relied upon Weisman to teach all of these recitations. The Examiner cited FIGs. 5-10 and lines 19-27 in col. 1 and lines 54-59 in col. 4, in support of the rejection.

As discussed with respect to claim 38, the cited passage from Weisman does not support the Examiner's position. Applicants respectfully submit that Weisman teaches a method for imaging internal anatomy of a patient. In particular, Weisman teaches a method that facilitates a user to generate reports, and to store, to retrieve and transmit digitized images and reports. After careful review, Applicants reiterate that Weisman does not teach specifying a probe geometry characteristic by interacting with a first graphical user interface window, specifying an imager parameter by interacting with a second graphical user interface window, specifying a weighting coefficient for an image quality parameter by interacting with a third user interface window, and creating computer files comprising specifications specified during the specifying steps in response to an input to a fourth user interface window.

For the reasons summarized hereinabove, Applicants respectfully submit that there is no motivation to combine McKeighen, Angelsen, Walker, Weisman and Vilser. And even if the references were to be combined, the combination fails to teach the above-mentioned recitations of independent claim 39. In particular, Applicants respectfully submit that the Examiner has failed to provide a basis in the art for combining the applied references that would support a *prima facie* case of obviousness for the independent claim 39 and respectfully request the Examiner to reconsider rejection of the claim.

Conclusion

In view of the remarks and amendments set forth above, Applicants respectfully request allowance of the pending claims. If the Examiner believes that a telephonic interview will help speed this application toward issuance, the Examiner is invited to contact the undersigned at the telephone number listed below.

Respectfully submitted,

Date: 5/31/2005

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